Unit 4

Linear Functions

5 - 6 Weeks

Connecticut Common Core

Algebra I Curriculum

Today's Presenters

Today's Agenda

- Unit 2 Overview (20 minutes)
- Unit 2 Workshops
  - Investigation 1: What Makes a Function Linear? (30 minutes)
  - Investigation 3: Calculating and Interpreting Slope (30 minutes)
  - Break (10 minutes)
  - Investigation 4: Effects of Changing Parameters in Slope-Intercept Form (30 minutes)
  - Investigation 6: Point-Slope Form (30 minutes)
- Assessment (10 minutes)
- Unit Planning (20 minutes)

Unit Content

- Investigation 1: What Makes a Function Linear? (2 days)
- Investigation 2: Recognizing Linear Functions from Words, Tables and Graphs (4 days including quiz on Investigations 1 and 2)
- Investigation 3: Calculating and Interpreting the Slope (3 – 4 days)
- Investigation 4: Effects of Changing Parameters of an Equation in Slope-Intercept Form (3 – 4 days)
- Mid-Unit Test (2 days including review)

Unit Contents (continued)

- Investigation 5: Forms of Linear Equation: Slope-Intercept and Standard (3 – 4 days)
- Investigation 6: The Point-Slope Form of Linear Equations (3 – 4 days)
- Performance Task: Linear Models (2 days)
- End of Unit Test (2 days including review)

What Students Need to Know

- Constant rate of change
- Slope
- x and y intercepts
- Slope-intercept form
- Standard form
- Point-slope form

What Students Need to Be Able to Do

- Determine if a function is linear from words, tables, equations and graphs.
- Determine the slope of linear functions represented in words, equations, tables and graphs.
- Given a linear equation in any of four representations- algebraic, graphical, tabular or verbal - write it in any of the other three.
- Transform equations of lines to either slope intercept or standard form.
- Use linear functions to model and analyze real world situations and solve practical problems.

Investigation 1: What Makes a Function Linear? (2 days)

Students:

- Distinguish between linear and non-linear functions in the context of distance-time graphs using a motion detector.
- Discover that a constant rate of change , or "walking steadily", creates straight-line graphs; slowing down and speeding up create concave graphs.
- Discover the effect that the magnitude, direction and starting place of their walk has on the graph of the distance-time function.

Investigation 2: Recognizing Linear Functions from Words, Tables and Graphs (3 days)

Students:

- Represent linear functions in verbal, tabular and graphical forms for real world contexts and situations.
- Learn to recognize constant additive change – and, thereby, linear functions - in verbal, tabular and graphical forms of a function.
- Connect real world contexts connect the mathematics.

Quiz on Investigations 1 and 2 (1 Day)

This quiz assesses whether students can:

- Determine if a function is linear given a table of values
- Sketch a graph of a linear functions from verbal descriptions of real world situations, including distance-time functions, and vice versa
- State the meaning of the intercepts and other ordered pairs in context
- Identify the intercepts and whether a function is increasing or decreasing from a verbal description, graph or table of values

Investigation 3: Calculating and Interpreting Slope (3 – 4 days)

Students will:

- Determine run, rise and slope given two points, and thus develop the slope formula
- Identify slope from a verbal description, table or graph of a real world situation
- Recognize and interpret rates in the form of units of the y per units of the x
- Identify increasing functions as having positive slope and decreasing functions as having negative slope

Investigation 3: Calculating and Interpreting Slope – continued (3 – 4 days)

Students will:

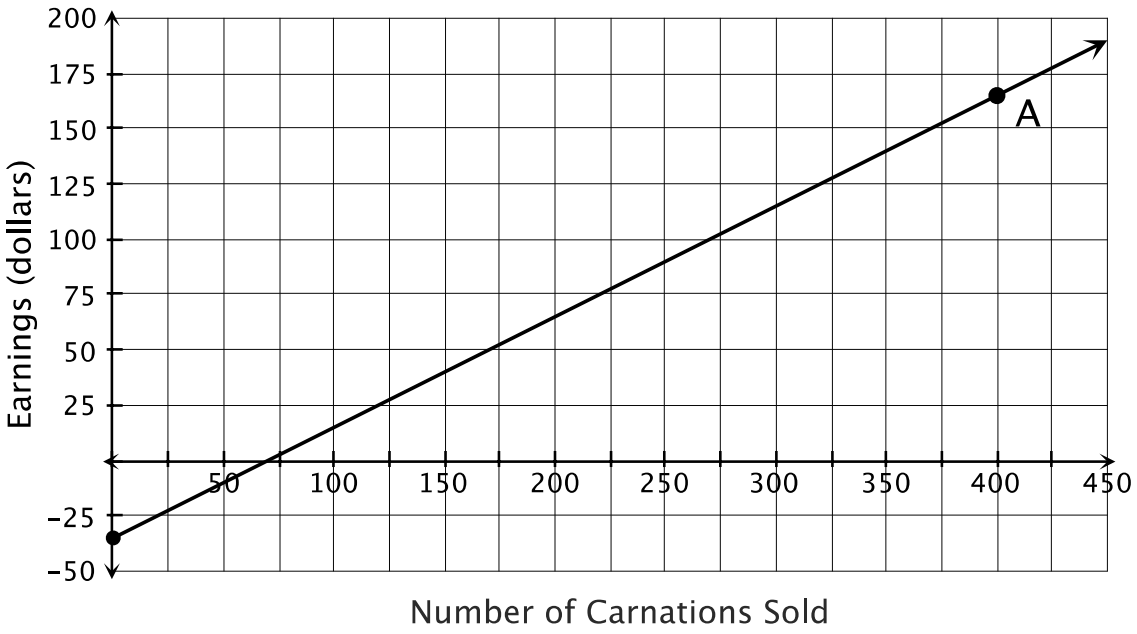
- Identify larger absolute value of slope with steeper lines
- Graph a line by creating a table of values when given an equation
- Graph a line given a point and the slope
- Identify and graph horizontal and vertical lines
- Determine whether lines are parallel, perpendicular or neither

Investigation 4: Changing Parameters (3 – 4 days)

- Using technology, students examine the effects of changing the parameters *m* and *b* in the slope-intercept form of a line.
- Students write the equation of a line in slope intercept form given a verbal description of a situation, a table of values or a graph of a linear function.
- Students interpret the meaning of slope and y-intercept in context.
- Students will learn to identify pairs of lines that are parallel or perpendicular from their slopes.

Mid-Unit Review and Test (2 days)

The graph below represents the earnings of Laticia and Tori. They sold carnations to raise money for their class dance. The florists delivered the carnations to Laticia and Tori and charged them $35 for the delivery. The cost of each carnation is 25 cents. They decided to sell each carnation for 75 cents.



How many carnations must be sold before the girls start making money?

Tori and Laticia want to make $100. How many carnations must they sell?

Explain how the graph would change if the girls charged more for each carnation.

Explain how the graph would change if the delivery cost was $50 instead of $35.

Explain the meaning of point A in the context of this problem.

Investigation 5: Forms of Linear Equations (3 – 4 days)

Students will:

- Recognize the standard and slope intercept forms of a linear equation
- Solve direct variation problems and recognize that direct variation is a linear function that has

  y-intercept = 0 and

  slope y/x = constant of proportionality
- Find the x- and y-intercepts of an equation, interpret them in context, use them to graph an equation
- Transform standard form to slope intercept form

Investigation 6: Point Slope Form of Linear Equations (3 – 4 days)

- Students will write the equation of a line in slope-intercept form, point-slope form, or standard form given:
  - the slope and *y*-intercept,
  - the slope and one ordered pair on the line,
  - two ordered pairs or
  - an ordered pair and an equation of a parallel or perpendicular line.
- Students will identify the advantages of each of the 3 different forms of the line and choose among the them

Investigation 6: Point Slope Form of Linear Equations (continued) (3 – 4 days)

Students will:

- transform an equation from slope-intercept or point-slope to standard form.
- transform an equation from point-slope or standard form to slope-intercept form.
- identify when sufficient information is given to write an equation of a linear function that models a real world situation.
- make predictions based on the meaning of the function.
- use slope and intercepts to analyze real world problems.

Performance Task: State of the States (2 days)

- This performance task:
  - Requires students to work with data for the populations of Connecticut, Kansas, Louisiana, and Nevada between the years 2000 and 2008.
  - Assesses students' ability to distinguish linear from non-linear function, and increasing from decreasing functions.
  - Find a linear equation to model nearly linear data.
  - Compare linear two different linear models
  - Use the linear model to predict population.
  - Evaluate the accuracy of the model.

End-Unit Review and Test (2 days)

- Students will be able to answer the following questions:
  - Given the graph of a linear function, including a horizontal line, identify the corresponding equation, create a table of values, identify the y-intercept and slope, and write the equation of a line parallel and a line perpendicular to the given line.
  - Find the point slope-form of an equation between two points, and transform the equation into slope-intercept form.
  - Choose which of 3 forms of a linear equation to use to model a contextual situations, identify and explain the meaning of the slope and the y intercept in context.
  - Choose a linear model, graph or table to predict or analyze something in a contextual situation.

Investigation Exploration

Participants will break into four groups. Each group will participate in the following four workshops:
(30 minute rotation)

- Workshop 1: Investigation 1
- Workshop 2: Investigation 3
- Workshop 3: Investigation 4
- Workshop 4: Investigation 6

Assessment Plan

- Investigation 1: What Makes a Function Linear?
  - **Exit Slip 4.1.1** asks students to draw qualitative graphs of someone walking with the motion detector.
  - **Exit Slip 4.1.1** asks students to draw quantitative graphs of someone walking with the motion detector given speed as well as direction.
  - **Journal Entry** asks students to draw a distance-time graph based on a story.

Assessment Plan

- Investigation 2: Recognizing Linear Functions from Words, Tables and Graphs
  - **Exit Slip 4.2** asks students to identify a function as linear or non-linear from a table and to explain their reasoning.
  - **Journal Entry** asks students to compare arithmetic and geometric sequences with linear and non-linear functions.

Assessment Plan

- Investigation 3: Calculating and Interpreting the Slope
  - **Exit Slip 4.3.1** assesses students' understanding of the relationship between slope and rate of change.
  - **Exit Slip 4.3.2** asks students to calculate the slope of a line and use the slope to determine its direction and steepness.
  - **Journal Entry** asks students to apply the concept of slope to a previously encountered function in context.

Assessment Plan

- Investigation 4: Effects of Changing Parameters of an Equation in Slope-Intercept Form
  - **Exit Slip 4.4.1** assesses student understanding of the parameters *m* and *b*.
  - **Exit Slip 4.4.2** has students apply the slope-intercept form of the line to a real world context.
  - **Journal Entry** asks students to think about the conditions that determine a line.

Assessment Plan

- Investigation 5: Forms of Linear Equation: Slope-Intercept and Standard
  - **Journal Entry 1** assesses students' understanding of when direct variation is a suitable model.
  - **Journal Entry 2** asks students advantages and disadvantages of two forms of the linear equation.
  - **Exit Slip 4.5** asks students to transform an equation from standard form to slope-intercept form and to graph an equation using two intercepts.
  - **Journal Entry 3** asks students to describe real world situations modeled by standard and slope-intercept forms

Assessment Plan

- Investigation 6: The Point-Slope Form of Linear Equations
  - **Exit Slip 4.6.1** assesses fundamental understanding of the point-slope form by asking students to identify the slope and the point from an equation and to write an equation given the slope and one point.
  - **Journal Entry 1** asks students to explain the meaning of point-slope form.
  - **Exit Slip 4.6.2** has students apply point-slope form in a real-world context.
  - **Journal Entry 2** asks students to evaluate advantages and disadvantages of point-slope form.

Common Core Content Standards (priority standard are in bold)

- F-IF 6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*
- F-IF 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
- Graph linear ...functions and show intercepts..
- F-IF 8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

Common Core Content Standards (priority standard are in bold)

- **F-LE 1.** Distinguish between situations that can be modeled with linear functions [and with exponential functions].
- **a. Prove that linear functions grow by equal differences over equal intervals...**
- b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another....
- **F-LE 2. Construct linear ... functions, including arithmetic ... sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).**
- **F-LE 5. Interpret the parameters in a linear ... function in terms of a context.**

Common Core Standards for Mathematical Practice (bold standards to be emphasized)

- *Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*

1) Make sense of problems and persevere in solving them.
2) Reason abstractly and quantitatively
3) Construct viable arguments and critique the reasoning of others.
4) **Model with mathematics.**
5) **Use appropriate tools strategically.**
6) Attend to precision.
7) Look for and make use of structure.
8) Look for and express regularity in repeated reasoning.

Assessment Review

- Mid-Unit Test
- Performance Task
- End of Unit Test

Reflective Questions

- In what ways can Unit 4 instruction be differentiated to support learners with different ability levels and learning styles?
- How can group work be incorporated into Unit 4 activities?
- How do Unit 4 activities foster the Common Core Standards for Mathematical Practice?

Unit Planning

- Discuss how to use the Assessments, the Unit plan and the Investigation Overviews to begin planning a unit.